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Page 76, Table 5.—Words "as invert" in column 2 to follow " Total sugars" in column 3.

Page 82, paragraph 3.—Bracket after " host-plant " to follow " attacked ".

For " indentifying " read identifying.

AGRICULTURAL JOURNAL

ISSUED BY THE

DEPARTMENT OF AGRICULTURE, FIJI.

VOL. 11.] DECEMBER, 1940. [No. 4.

EDITORIAL.

THE need for more self-sufficiency in the matter of the production of essential foodcrops was indicated in an earlier issue (No. 2) of this Volume, when it was pointed out that foodstuffs, which could be grown locally, were imported to the value of about £210,000 annually.

One of the important foodstuffs included in this category is dhall, which, with other pulses, is annually imported to the value of approximately £15,000. In this issue an interesting and concise article appears indicating the advantages to be gained by growing dhall and describing the various types which may readily be cultivated in the Colony.

The crop is highly suitable as a rotation crop with rice, maize, sugar cane, cotton and other crops, its deep-rooting system materially assisting in the aeration of soils and in the prevention of " hard pan " formation.

Several types of dhall have been grown successfully at the General Experimental Station, Sigatoka, and these trials indicated that some types could be grown to maturity in about three months, thus giving a quick return of a valuable food stuff.

Efforts are being made to induce Indians in particular to grow more of this crop, which is so beneficial agriculturally and so important dietetically in providing necessary protein for the large numbers of the community who prefer a vegetarian diet. It is hoped that the article in this issue will be widely read. A useful note on the cultivation of mustard is included.

The advent of the fly season should be sufficient to draw attention to the useful practical article on fly control measures prepared by Dr. Baxter, Medical Officer of Health, as a continuation of an article which appeared in the last issue, dealing with breeding places and the life history of the house fly.

Attention has been directed to the need for control of the fly pest for a number of years through the pages of this journal and it is pleasing to note that much has been done by the Health Department to destroy obvious breeding places. Much still remains to be done, however, and the public can assist very materially if individuals pay a little regular attention to the destruction of breeding places and their elimination in the neighbourhood of their own houses. It is anticipated that the public will co-operate with the Health Department in this important matter affecting, not only our comfort, but the general health of the people.

A further note on the troublesome weeds of Fiji is given in this issue. This deals with " nut grass " and indicates practical methods of controlling it, which should prove of value to all classes of agriculturists, as should the first of a series on Plant Protection.

Observations on a number of common weeds in various countries made by Mr. Simmonds in the course of investigations on the biological control of the rhinoceros beetle are recorded in this issue as of possible utility in indicating control action in the countries concerned, These observations will be read with interest as comparisons with well-known weeds in Fiji.

A short note on making charcoal is included in this issue since the method described may prove of local practical use.

Under "Extracts" are very important notes on the preservation of fish in warm climates and preparation of tomato juice. The former deals with the refrigeration, salting and smoking methods of preserving locally caught fish. It should prove of special interest just now, when efforts are necessary to utilize more locally available food products rather than the imported articles.

The Colony imports annually more than £20,000 worth of tinned fish, which, while it serves a convenient purpose, lacks the nutritive value of fresh fish locally preserved, so that this article merits close attention as a worthy alternative to tinned fish in those areas where fish can be caught economically.

Amongst "Reviews" is a recent article on insect pests of stored food-stuffs which is a subject of increasing vital concern in these days when shipping facilities, on which this Colony largely depends for its staple food grains, are liable to restriction. It should, therefore, merit careful reading.

Also amongst "Reviews" are brief notes on the utilisation of kitchen waste for feeding farm stock and Jepson's beetle in other islands as far apart as Porto Rico and Rarotonga.

THE PRODUCTION OF DHALL.

By
C. M. DASS,
Indian Agricultural Instructor.

Pulses (dhall) form an important item in the diet of a community which is either vegetarian or partakes of flesh to a limited extent only. A considerable percentage of the members of the Hindu community in Fiji come under this category. The deficiency in proteids in vegetarian diets may be made up through the inclusion of increased quantities of dhall or pulses.

Some idea of the large quantities of dhall consumed by Indians and others in Fiji is indicated by the importation from overseas in 1938 of 774 tons of this commodity valued at approximately £10,000.

The possibility of producing a varied number of pulses in Fiji has been demonstrated repeatedly and our dependence upon other countries for these commodities does not appear to be justifiable. The soil, climatic and cultural requirements can be met easily and satisfactorily. Most of these pulses (or legumes) may be made to fit admirably and profitably into a rotation scheme with padi, maize, sugar-cane, cotton and other crops, some may be grown as inter-crops between vegetables, &c., and one at least (Arhar) may be cultivated in shallow, stony and otherwise waste land to the improvement of the soil and the advantage of the grower.

In addition to producing a cash or food crop, legumes increase the fertility of the soil. This is done in an interesting way: if a leguminous plant is dug up and its roots examined, it will be found that a number of bead-like nodules are present. These nodules contain bacteria which have the power of extracting nitrogen directly from the air and passing it to the plant in a form in which it can be readily assimilated. When the crop is harvested and the stems, leaves and roots of the plant returned to the soil the latter is enriched by the decay of the straw, forming humus, and by the release of nitrogenous compounds.

The plant of the Arhar Dhall is deep rooted and its inclusion in a system of rotation with sugar-cane, maize, cotton or padi is advantageous because the deep roots break up the pan which forms beneath the ploughed surface of the soil.

Thus, the growing of edible legumes serves the dual purpose of producing a marketable food crop and maintaining soil fertility and improving tilth.

The following pulses commonly consumed as dhall may be produced profitably in certain parts of Fiji:

Arhar (*Cajanus indicus*) also known as pigeon pea, Congo-bean and red-gram.
Urd (*Phaseolus mungo* var).
Mungh (*Phaseolus mungo* var).
Cowpea, Giant and Dwarf (*Vigna catiang*).
Soya Bean (*Glycine hispida*).

AHAR.

This pulse is the most widely used and is the chief dhall imported from India.

The plant is a perennial shrub reaching a height of six to eight feet, is deep rooted and resists drought well. Though it is capable of producing a crop in shallow, barren soils, best yields are obtained when grown in fairly deep soil, not too rich but well-drained. Like most legumes it is intolerant of wet soil conditions and bad drainage. In Fiji good crops are produced in Nadi, Lautoka, Ba and Ra districts. Elsewhere it does not seed on account of the prevalence of mists or of excessive rain.

Arhar may be grown either as pure crop or inter-crop, the seed rate per chain varying from a half pound to two pounds depending upon the spacing and methods adopted. It is usually grown as a pure crop and sown broadcast, one or two weedings and mulchings being necessary in the early stages of growth.

The crop matures during the dry months (June to October) about six months from sowing and thereafter the plants are in bearing throughout the year.

The simplest and cheapest method of harvesting consists in cutting the heads which bear the pods with a sickle and threshing out the seed by beating on a platform or treading with bullocks.

Before marketing, the seed is dried in the sun for two or three days, cracked in halves in a " Chakki " and the husk removed by winnowing.

An average yeild of about 90 lb of seed per chain as a pure crop and 20 lb to 30 lb as a mixed crop may be obtained.

The retail price of Arhar dhall is about 3d. per pound.

URD.

Urd comes next in popularity to Arhar as an article of food. In addition to serving as an ingredient in soups and curries it is used widely in making " biscuits " such as " bara," " phulauri " and " papar."

The plant is an annual shrub with long, trailing stems and bears clusters of hairy pods. The seed is larger than that of Mungh ranging in colour from dark green to dark brown.

The crop is most economically grown in rotation with padi if proper drainage is provided. After the padi is harvested the field should be ploughed and worked up to a fine tilth. Urd is then sown broadcast using seed at the rate of about two pounds to the chain. Germination takes place in a

few days. If the land has been prepared thoroughly little weeding is required, the trailing habit of the plant making an effective cover. The crop matures in about ten weeks from sowing.

Harvesting is done in two ways. One consists in picking the pods by hand; this method is tedious and uneconomical. The better method is to cut the vines with a sickle, dry them on a tarpaulin, and beat out the seed with sticks or tread it out with bullocks. Whichever method is adopted it is essential that all trash be returned to the soil. This is best done by spreading the vines, leaves and husks on the surface of the field and ploughing them in; this helps to maintain soil fertility. An average yield of 50 lb of seed per chain may be expected, and the retail price varies from 2d. to 3d. per pound.

This crop thrives best in the dry zones.

MUNGH.

Is used in similar ways to dhall but to a much less extent than either Arhar or Urd. A sweet, rather palatable dish is also made from it known as "pisum" which is much relished by the Malayalam section of the Indian community.

The plant is a small, erect, slightly hairy annual, bearing narrow, cylindrical, straight, radiating smooth pods about three inches long. The seed is smaller that that of urd, ranging in colour from yellow to pale green.

Mungh may be grown either in rotation with padi or as an inter-crop with cotton, maize or sugar-cane; cultural requirements are similar to those of urd. The seed rate is one and a half pounds to the chain, if grown as a pure crop, and half a pound as an inter-crop. The crop matures in about ten weeks from sowing and requires little attention other than occasional weeding.

Harvesting may be done either by picking the ripe pods by hand or by pulling up the entire plant. Threshing is done in the usual way. All trash should be spread over the land and ploughed under. A yield of 95 lb per chain has been obtained at the General Experimental Station, Sigatoka, and the retail price is about 2d. per pound.

COWPEA.

There are two main varieties to be found in cultivation all over Fiji—Giant and Dwarf. If grown during the dry, cool months the plants of both varieties present a compact, bushy appearance and produce pods in abundance.

The giant cowpea pods are usually about nine inches long, comparatively broad and flat turning a deep purple when approaching maturity. The seed is larger than that of the dwarf variety and brown in colour. The pods of the dwarf variety range up to six inches in length, are more cylindrical in shape and are straw-coloured when ripe. The seed varies in colour from white to black through all the intermediate shades, some being mottled and some brown, according to the numerous types in existence. In the young state the pods may be used as a vegetable.

The soil and climatic requirements are similar to those of Mungh and Urd. If grown for seed, thorough preparation of the field is essential. Planting should be done in drills spaced from 2 feet 6 inches to 3 feet apart and 12 to 18 inches apart in the drills. (This allows for inter-row cultivation with a horse or bullock-drawn implement in the early stages of growth.) The seed rate is one and a half to two pounds a chain. When grown as a cover crop the seed is sown broadcast at from two and a half to three and a half pounds a chain.

The crop matures in about four months, the giant varieties taking longer than the dwarf. The ripe pods are picked by hand, dried in the sun and threshed by beating with sticks or treading by animals. The preparation for market consists in cracking the seed in halves and winnowing out the husks.

The great drawback with cowpea dhall as a commercial pulse is its marked susceptibility to pea weevil infestation in storage.

The yield of seed varies from 80 lb to 180 lb a chain according to variety and time of planting and the retail price is about 2d. per pound.

SOYA BEAN.

Soya bean has great possibilities in Fiji. In China, Japan and certain parts of India it is an indispensible article of diet. Its low carbhoydrate content renders it a suitable food for diabetic patients. The oil which is extracted from the seed is used widely in the manufacture of margarine and soap and the residue is made into cakes and fed to cattle. The residue also comes into use in the manufacture of window mouldings in modern motor cars, buttons and utensils of various sorts.

The plant varies greatly according to variety and is an erect annual shrub ranging in height from two to four feet. The taller varieties are used exclusively for fodder. The shrub bears along all its branches clusters of short, hairy pods containing three to four seeds which vary in colour from yellow to brown according to variety.

The dry zone of Viti Levu appears to be well suited to the growing of soya beans; good crops have also been produced in the wet zone.

Soya beans thrive best in deep well-prepared soils. Sowing is done towards the end of the rainy season in drills 3 feet apart and 12 inches to 18 inches apart in the drills. Seed should not be planted deeper than two to three inches. About two and a half pounds of seed will plant a chain.

The growth is slow at first and weeds are likely to be troublesome. Regular cultivation with the scuffler and one or two hand weedings help to establish the crop, which ripens in about five months.

Harvesting and threshing are done in the usual way. Care should be taken to return all trash to the soil.

Yields obtained at the General Experimental Station, Sigatoka, and Central Agricultural Station, Navuso, are approximately:—

1,500 lb of seed per acre (150 lb a chain) as a pure crop.

650 lb of seed per acre as an inter-crop planted with cotton.

APPENDIX.

(from Macmillan's *Tropical Planting and Gardening*)

ANALYSIS.

	Water.	Proteids.	Carbo-hydrates.	Oil or Fat.	Fibre or Cellulose.	Ash.
Pigeon Pea (Arhar) ..	10·5	22·3	60·9	2·1	2·1	3·0
Urd .. .. / Mung	10·8	22·2	54·1	2·7	5·8	4·4
Cowpea	12·5	24·1	56·8	1·3	1·8	3·5
Soya Bean	11·0	35·3	26·0	18·9	4·2	4·6

"SATUA"—A NUTRITIOUS INDIAN DISH.

By
S. BHARAT,
Indian Field Assistant.

In India all grains and almost all dhalls are used for making "Satua," but the Satua prepared from barley and gram is most prized. Here, in Fiji, it is made from rice, maize, peas, gram, urd, mung and beans. Generally, all of these are not used at the same time, but two or more varieties of grains, such as rice, maize and urd are used.

The whole grains (different varieties being kept separate) are immersed in water overnight and then sundried, with the exception of padi, which is heated in water till the husk begins to swell and then strained, dried in the shade and milled in a "dhenki". The various kinds of grains are put in pots containing sand and heated until cooked thoroughly. The pots are allowed to cool and, after sieving to separate the sand, the grains are ground between two stones ("janta"), specially made for the purpose. After grinding separately, all the different varieties are thoroughly mixed and at times a condiment known as "jeera" (a spice-dill) is ground and sprinkled on it. Prior to eating, salt or sugar according to taste is added, and then cold water is poured over it gradually while the mixture is stirred slowly with a spoon or with the fingers. When it forms into a soft dough it is ready for eating.

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2. THE CONTROL OF THE FLY NUISANCE.

From *Health Bulletin* (Victoria, Australia) Jan.-June, 1940.

Adapted by G. R. BAXTER, M.D., D.P.H., Medical Officer of Health, Suva, from the article in the above Journal.

By
T. W. HOGAN.

L.C.

The previous article gives details about the life-history and breeding habits of the common flies found in dwellings in Fiji. We are now concerned with the problem of controlling these pests and carriers of disease.

The control of flies can be regarded from two aspects:—

Firstly, decreasing the opportunities of flies to spread disease; this resolves itself into problems of sanitation and means preventing flies reaching both infective material and food.

Secondly, the limitation of the numbers of flies. This reduces the chances of their spreading disease and reduces the worry and annoyance they cause.

Although these two aspects should be kept in mind, they will not be dealt with separately as one usually involves the other. Thus in preventing flies gaining access to human excreta so that they cannot spread disease, the breeding of flies is also prevented.

True control of house-flies can be obtained in only one way, and that is by preventing them from breeding. As satisfactory control of this means is not always practicable, however, destruction of the adults and their exclusion from dwellings, &c., must also be considered.

I.—PREVENTION OF FLY BREEDING.

Flies breed in horse and cow manure, kitchen or cook-house refuse, and human excreta. They will breed in fermenting vegetable matter of any sort, but the foregoing comprise the most important breeding places.

(1) Horse Manure.

Flies are most attracted to horse manure while it is moist and fresh. Hence it is important to collect manure regularly and frequently and arrange for its disposal before flies can breed in it. If it is not possible to dispose of it daily it should be stored in fly-proof or covered pits, though this is seldom done.

The following methods are used for its disposal:—

(*a*) *Incineration.*

This is the most certain way of preventing fly breeding, but involves considerable trouble and expense and destroys what would otherwise be valuable material for crop cultivation. For this reason it is seldom used, except in military camps when sometimes it is not possible to arrange for its removal by contractors. In this case, the manure is burnt in trenches or incinerators of which the Centre Cone type is very efficient.

(*b*) *Tight packing of manure.*

Owing to the heat generated by fermentation, the interior of a pile of fresh manure becomes too hot for fly larvæ to live. If the manure is packed tightly this tendency is increased, and only the outside material is at a suitable temperature for fly breeding. This can then be treated with borax, as described below, or sprinkling the edges and adjacent soil with crude oil. The manure can be compacted by driving over it with each fresh cartload, and pounding it with a spade. The side of the pile should be kept perpendicular.

In a military camp, the manure is sometimes covered with earth four to six inches deep, taken from a trench dug around the manure pile.

(*c*) *Chemical treatment of manure.*

Borax dissolved in water at the rate of 11 oz. to 10 gallons and applied to 8 bushels of manure will kill eggs and maggots. Excessive borax will prevent plant growth, but 15 tons per acre of this manure will not injure plants.

(*d*) *Maggot traps.*

For permanent places like stables, cowbails, horse lines, &c., maggot traps are extremely useful and efficient. These take advantage of the "migration" of the larvæ to find a place to pupate. The larvæ are allowed to mature, but are trapped and killed when leaving the manure heap to find a dry place for the resting or chrysalis stage. Two types are in common use:—

Hutchinson's trap is essentially a large raised grating over a concrete trough containing water. On attempting to migrate the larvæ are caught in the trough and destroyed or drowned.

Baber's trap is a modification in which the manure is packed in wire cages which have a brick or concrete base and surrounded by a gutter containing water. The migrating larvæ are caught in the gutter.

(*e*) *Spreading of manure.*

In hot weather the manure can be spread out so thinly that it rapidly becomes too dry for larvæ to develop and also does not afford protection from the heat. It can be scattered over fields and used as a fertilizer. The

manure should not be more than an inch thick. The weakness of this method lies in the danger of odd pockets of manure occurring in irregularities of the ground and permitting flies to breed.

(2) Cow Manure.

Most of the above methods can be adapted for use at dairy farms.

In Fiji the problem of cow dung is even more important than horse manure. A good deal depends upon the weather. In wet weather the maggots developing from the eggs can reach the interior of the mass and escape being destroyed by ants, their natural enemies. Considerable search has been made to find a suitable natural enemy which will prey on the larvæ, and one has been introduced in the hope that this will be effective in some degree. Cattle are always associated with flies and always will be, and cattle should be excluded from residential or closely built up areas, if freedom from flies is desired. In wet districts cattle hoof marks—often more than a foot deep are also prolific sources of *Culex* mosquitoes, a fact not sufficiently realised. Sawdust soaked in crude oil and scattered broadcast is a useful way of dealing with these difficult breeding places, which are almost impossible to deal with otherwise.

(3) Disposal of Garbage and Food Waste.

Flies will breed in any fermenting organic matter.

Waste food and garbage are next in importance to horse manure as a breeding ground for flies. Such material should therefore not be allowed to lie about but immediately placed in fly-proof containers. Moreover, general cleanliness and good sanitation are essential wherever food is being prepared, as otherwise flies are attracted to the very place where it is most desired to exclude them.

An efficient and regular garbage service is the first essential in any attempt to control flies. This is however only possible in towns, and costs money.

The following remarks apply mainly to rural districts.

Burning is the best means of disposing of kitchen refuse, and it is astonishing how much can be got rid of in this way. Simple bush type of incinerators can easily be devised from old drums—by raising them off the ground and making suitable perforations. If burning is not possible, garbage, &c., should be buried as deeply as possible covering with earth, daily if possible, to prevent flies having access to deposit eggs. Old fruit tins, corned beef tins, sardine tins, scattered about not only attract flies by the decomposition of fragments left in them but also are a most prolific source of mosquito breeding later on. No tropical sanitation is complete without most careful disposal of tins and bottles, &c., both for fly and mosquito control.

Carcases have occasionally to be disposed of in rural districts. Burying with lime is the only satisfactory method.

(4) Disposal of Human Excreta.

The importance of this measure lies in the prevention of disease transmission rather than fly-breeding which may take place. The greatext care must be exercised in camps, because the prevention of the spread of excremental disease, such as typhoid and dysentery, depends upon the thoroughness with which proper precautions are carried out. Flies do breed in human excreta, but they are more attracted to it for feeding purposes, and there is ample evidence to show that flies will travel back and forth from the latrine to human food in the camp. A fact worth remembering is that flies dislike crude oil, and will avoid latrine pails smeared with it.

INSECT PESTS OF CITRUS, PINEAPPLE AND TOBACCO.

By
R. J. A. W. LEVER, B.Sc., D.I.C., A.I.C.T.A., F.L.S.

Citrus.

In Fiji the worst pests of citrus are the two fruit-flies *Chætodacus* (*Strumeta*) *passifloræ* Frogg. and *Notodacus xanthodes* Broun which have been dealt with in detail by Simmonds (1) who also refers(2) to two sucking bugs *Mictis profana* F. and *Tectocoris lineola* F. which damage the shoots. Some half-dozen scales are recorded comprising: *Fiorinia proboscidaria* Green, *Chinoaspis citri* Com., *Lepidosaphes beckii* (Newm.), *Pseudococcus citri* (Risso), *Coccus hesperidum* L. and *Aonidella aurantii* Mask. which was said (3) to be absent. The only mealy bug recorded is *Icerya seychellarum* West. Injury to the fruit is done by the piercing mouth-parts of the moth *Othreis fullonica* L., its brightly coloured larva eating the leaves as does the same stage of the swallow-tail butterfly *Papilio schmeltzi* H. Sch. Tent fumigation, so necessary in Palestine and California, is not required in Fiji.

Certain pests have either not been recorded or not identified, particularly the black-aphis, *Aphis citricidus* Kirk. which is often abundant on all young growth where it has been controlled by kerosene emulsion and more recently by Diesel oil which is much cheaper (4) and equally effective for scales. Two weevils do some damage, especially the larger which attacks leaves, where lead arsenate spraying will check its depredations. This is *Rhinoscapha oblita* Heller, a black beetle about 29 mm. long with red spots on the wing cases which have a white marginal streak. The smaller is brown and only 5 to 7 mm. long and is *Elytroteinus subtruncatus* Frm. which has been found damaging lemon fruit and is eaten by the introduced toad. Two small wood-borers, *Xyleborus testaceus* Wlk. and *Crossotarsus saundersi* Chap. were mentioned in a recent *Journal*(5) as being found in trunks of grapefruit trees which had inadequate drainage. Remedying this and whitewashing the trunks are satisfactory controls.

Pineapple.

Local pineapple pests do not appear to have been dealt with and since canning has been started, this is an increasingly important crop. The insect capable of causing the most severe damage is the Dynastid *Anomocaulus fulvovestitus* Frm., a brownish-black beetle measuring up to an inch in length. This injures the leaves and bores into the heart, but is fortunately very scarce. It was first recorded in 1914(6) on Vanua Levu and was described as a small species of rhinoceros beetle.

The well-known pineapple mealy bug, *Pseudococcus brevipes* (Ckl.), causes wilt throughout most regions where pineapples are grown except apparently Fiji and Zanzibar.(7) The writer visited pineapple areas on Ovalau in 1938 and although the bug was present no wilt was observed which is not the case in Hawaii, Malaya or Mauritius. In the latter island spraying with a one per cent. Dielsel oil emulsion every 6 weeks gives control(8) and could be used locally were the insect to become serious. So far as natural control is concerned, three species of lace-wing flies are predators on the bug —they were taken by Mr. G. S. Dun and two identified in London as *Chrysopa ramburi* and *C. irregularis*. The eggs of these gauze-winged insects are borne on delicate stalks and tiny Chalcid egg parasites emerged from some eggs sent to Hawaii. It appears to be *Telenomus chrysopæ* Riley.

The pineapple scale *Diaspis bromeliæ* Kerner has elongate slug-like males and circular conical females. Fortunately this is also not severe in Fiji where

the pineapple flourishes and seems able to tolerate this scale which in Hawaii can kill the plant.(9)

Very common on fruit damaged by *Anomocaulus* or thickly covered with *Pseudococcus* are at least four species of *Carpophilus* beetles, viz. *C. dimidiatus* (Fab.), *C. mutabilis* (Frm.), C. *hemipterus* (L.) and *C. humeralis* (Fab.). These are all brownish beetles with short wing-covers about 3 mm. long. Although they are regarded as secondary pests, through inability to damage fruit unaided, yet by getting into the canned fruit they constitute a nuisance. As they breed in decaying and fermented fruit and fruit-refuse the removal of these quickly checks them. In Hawaii it is found that owing to their attraction to strong light they can be controlled by cutting down the light in the canning sheds. Two other Nitidulid beetles are *Haptoncus ocularis* Frm. and *H. luteola* Err. respectively orange with two black spots on each wing-cover and uniform brown in colour. Both of these were taken on Taveuni and Ovalau in rotten citrus as well as pineapple.

Among diseased roots of the latter are found a burrowing cockroach *Pycnoscelus surinamensis* (L.), which is a South American insect now common in Fiji. The prompt removal of all diseased material is indicated as this cockroach might injure living roots as it does in Hawaii.(9) The swarms of vinegar-flies (*Drosophila*) which breed in exposed rotten fruit need no more than a mention.

Tobacco.

Tobacco is chiefly grown at Sigatoka with a rainfall of about 72 inches, the main varieties being Hybrid 142 and Resistant Havana. The chief damage comes from the cut-worm *Heliothis armigera* (Hbn.) and *Agrotis ypsilon* Rott. The poison bran bait mentioned in the issue for October, 1939, should be made up into pellets and scattered between rows in the late afternoon allowing 3lb of dry bran for 1,000 plants. Jepson's " dark-green caterpillar with a pale band running down each side "(10) is almost certainly *Heliothis*. The present writer has recently bred two small Phorid flies from dead caterpillars of *Heliothis*, viz. *Diploneura cleghorni* Big. and *Megascelia scalaris* Low. Another moth whose larvæ do harm is the leaf-miner or borer *Phthorimæa operculella* Zell. This was listed as a pest on Kadavu in 1915(11) but does not now seem to be serious. The moth is mottled dark grey with a wing span of 13 mm. and females may be prevented from laying on the leaves by means of a calico or hessian cover placed over the seedlings. Bordeaux mixture as a spray or lead arsenate dust are the best control for the larvæ which mine within the leaves. They may be crushed in this position by hand when the blotch is visible on the leaf surface. Plant sanitation is also very important.

The closely allied stem-borer *Gnorimoschema heliopa* (Low.) was recorded from Wallis (Uvea) and Futuna (Hoorn) Islands besides Vanua Levu.(12) This does not appear to be any longer a pest but the Philippine method of cutting out the caterpillar from the swollen stems should be followed with vigorous plants, weak ones should be uprooted and burnt when young. Here again crop sanitation by destruction of old plants at the end of the season and early transplanting of the seedlings are important measures. The moth is coppery red to reddish brown with a wing-span similar to that of *Phthorimea* but the attack is via the leaf-midrib into the stem instead of between the leaf surfaces and so will distinguish the two. Compared with cutworms, however the leaf-and stem-borer are of much less importance.

The only beetle pest recorded in the field is the yellow ladybird spotted with black, *Epilachna 28-punctata* F. which was dealt with in Volume 10, No. 1, on Vegetable Garden Pests. Lead arsenate sprays or pyrethrum dust

are best for control. Neither flea-beetles nor hawk moths appear to be recorded as tobacco pests in this Colony though damage from the caterpillar of the latter often defoliates whole plants in other tobacco-growing countries. The cigarette beetle *Lasioderma serricorne* L. tunnels in cheroots and cigars if left exposed. Fumigate with carbon bisulphide at the rate of one ounce for fifty cubic feet—say, 4 x 4 x 3 feet.

In 1915 Jepson reported damage on Kadavu by a so-called "suck-fly" given as *Dicyphus minimus*.[10] This is taken to be the small green Capsid bug *Engytatus tenuis* Reut., with a very wide distribution including the isolated atoll of Sikaiana in the Solomons. As it frequents the sticky lower surfaces of the leaves, care must be taken to reach here if it were to be abundant enough to warrant kerosene emulsion spraying.

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NOTES ON WEEDS IN FIJI—IV.

By
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THE following notes refer to weeds which have been sent in for identification or which have been recorded for the first time or noted as being on the increase:—

II. NUT GRASS—*Cyperus rotundus* L. Cyperaceæ (FAM.).

FIJIAN NAME MALAGA, SORONAKABANI.

Nut grass is a well known weed in many countries and has been the subject of much investigation in Australia, Hawaii and United States.

It is pan-tropic in occurrence and is also found in temperate lands.

In Fiji it is widely spread especially in arable land where its control is a major problem for the cultivator.

Description.—Rhizome creeping or stoloniferous, swelling into truncated tubers. Stems rather slender, 1–1½ft. high, triquetrous towards the apex. Leaves rather narrow, shorter than the stem, sheaths often long and loose.

Spikelets usually 6–10 together in clusters or short spikes in an umbel of a few rays, the outer ones sometimes slender and 2–3 in. long; but more frequently the umbel rather dense almost contracted into a compound cluster. Spikelets usually of a rich brown colour, linear, acute compressed but not very flat, usually about ¾ in. long and 1/12 in. broad, with 12–20 flowers.

Glumes imbricate, not very broad, obtuse to rather acute, several nerved, with a prominent keel usually green. Stamens 3. Style 3-cleft. Nut obovoid, 3-angled scarcely half the length of the glume.

Distribution.—The plant is propagated by seed and also by means of underground corms which are spread in the field by implements during cultivation. It has also been transported from place to place in soil and

in wrappings of grass about the roots of seedlings and even in seed potatoes. During floods the corms may be transported long distances and deposited on alluvial flats where infestation is frequently very heavy.

Status as a Weed.—In Fiji, nut grass is a serious weed of agricultural and horticultural land—especially of the river valleys. It grows equally well in the sandy alluvial loams and in the heavy clay soils and is extremely difficult to eradicate. It is a perennial plant spreading mainly by the underground rhizomes which produce corms at intervals. Studies at Canberra have shown that as many as seventy-six new corms may be produced in a single season from a single parent corm. It is especially dangerous as a competitor of young field crops as maize, soya bean, sugar-cane, &c., owing to its rapid growth and extensive root system. When the crop germinates there is usually a green sward of rapidly growing nut-grass shoots which quickly stifle the young plants.

Control.—The following notes are recorded regarding the control of nut grass in Australia:—

(1) Experiments in Queensland have shown that cultivation of the ground at not less than three weekly intervals during two growing seasons will reduce nut grass to negligible proportions.

(2) No chemical treatment short of soil sterlization has been effective in controllong nut grass.

(3) Control by means of insects has been considered: but it does not appear likely that the nut grass insects from Hawaii can be liberated in Australia for fear that they might attack useful species of *Cyperus* which form the chief grazing plant in certain pastoral areas (²).

In Fiji, direct control has been attempted by the importation from Hawaii of a moth (*Bactra*) and a weevil which assist to destroy the plant. Field observations indicate that the former has been successfully liberated and may be said to exercise a slight measure of control but the latter has failed to become established.

In rotation plots at Central Agricultural Station a satisfactory control of this weed has been achieved by eliminating a weed-fallow—that is, by growing a green manure crop in its place. In banana and citrus plots the weed has been smothered by constant cover-cropping with rice bean and cowpeas.

Nut grass prefers open situations and its growth is poor if overshadowed by a cover-crop or by such a crop as tapioca. Competetion by nut grass with young crops of maize and soya bean has been reduced to a minium by thorough preparation of the seed-bed and by rolling with a Cambridge roller after the seed is sown. The effect of this is to retard the growth of the weed and a single early weeding has usually proved sufficient to give the crop plant the necessary start.

In small areas, such as gardens, nut grass may be completely eradicated by the systematic removal of the soil to a depth of nine inches and its replacement with non-infested soil. Fowls eat the corms if the soil is sufficiently loosened, and an actual case of this form of control (which is practically permanent in effect) has been demonstrated by Mrs. J. C. Chapman of Wainivau.

Chinese market gardeners combat the weed by constant intensive cultivation of the soil.

Unsuccessful attempts have been made locally to control nut grass by repeated burning off of the foliage with the aid of the flame-thrower in the hope of exhausting the reserves of food stored in the corms by successive and frequent destruction of the foilage.

The control of this weed is largely a matter for the individual who must deal with it by the best method possible under the particular circumstances of the locality and the type of cultivation.

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(*To be continued*)

PLANT PROTECTION.

(Notes from the Plant Pathological Laboratory—I.)

By
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MANY requests are received by the Department of Agriculture for advice concerning diseases of ornamental and economic plants.

Many of these diseases are caused by parasitic fungi or bacteria which feed upon organic matter in the form of living plants, while others are classified as virus diseases—a type of infectious disease of which no visible causative organism is known.

Familiar examples of diseases common in the gardens of Fiji are the following:—Wilt diseases of tomatoes, potatoes and ornamentals as *Antirrhinums*, Asters and *Zinnias* in which the whole plant collapses and dies; leaf diseases as the leaf-spot of *Gerbora* and of roses or mildews of *Zinnia* and virus diseases of tomato, corn and other plants often characterized by a bunching of the crown or a mosaic streak in the leaves.

Wilt diseases, which frequently cause excessive losses, may be due to soil-inhabiting organisms as *Fusarium* sp. or bacteria which enter the vascular tissues of the roots and destroy the plant. Other fungi, as *Sclerotium* and *Pythium*, attack plants at ground-level with similar results.

Damage to foliage is usually caused by one or other of a legion of parasitic fungi. The spores of these fungi are carried by wind and falling on the leaf become established there and feed upon the leaf-tissue. A common example is leaf-spot of bananas caused mainly by *Cercospora musæ*.

The gardener and cultivator is naturally primarily concerned with control measures, rather than with the identification of the causal agent but this latter information is usually necessary in order that correct recommendations for control may be given. The following notes deal briefly with some of the common diseases occurring in the Colony and with methods of control which may be used to combat them.

Further advice and information on individual cases may be obtained on application to the Department of Agriculture and in this connection it is necessary to make the following suggestions:—

(1) All requests for information should, where possible, be accompanied by specimens of the effected plants together with a note on the extent of the trouble in the field or garden and general symptoms noticed.

(2) Specimens should be placed between sheets of newspaper with a piece of cardboard as a stiffener and should be forwarded without delay.

GENERAL PRINCIPLES OF PLANT PROTECTION.

The preservation of plant health is best achieved by preventive methods, the carrying out of which in an effective way constitutes the practice of plant protection.

Briefly, the preventive methods aiming at the production of disease-free plants are: (1) the production and use of resistant varieties; (2) the use of improved cultivation methods—including a choice of soil, situation, fertilizers and the practice of plant sanitation; (3) the use of chemical substances which protect the plant from infection. Other methods may also be employed aiming at:—(4) the destruction of the parasite either on the seed or in the soil, (5) biological control and (6) the treatment of sources of infection and of the means by which infection is spread. Curative methods may also be adopted aiming at the destruction of the parasite after it has been established on the plant. This is usually accomplished by the application of toxic chemicals (4).

Some of these methods may appear beyond the capacity of the home gardener and the small-holder, but very striking results may be achieved by attention to simple methods of plant sanitation, which includes crop rotation, and to preventive measures such as seed sterilization and the use of resistant varieties. Spraying with chemical compounds or fungicides is both effective and economic, and in these days is made extremely simple by the availability of a number of compounds ready for immediate use on a small scale.

Reference will be made to some of these materials in the course of the following notes:—

WILT DISEASES—THEIR CAUSE AND CONTROL.

This type of disease is familiar to all gardeners—it is characterised by the drooping of the foliage, sometimes accompanied by yellowing also—and always resulting in the collapse of the plant.

(*a*) *Tomato Wilt.*

Causal organisms.—Two types of tomato wilt have been recorded locally: (1) Bacterial wilt caused by (*Bacterium solanacearum*) and (2) *Fusarium* wilt or " Sleeping disease," caused by *Fusarium* sp. Both organisms inhabit the soil—and both usually are wound-parasites, that is they enter the plant through wounds in the roots caused during transplanting or during cultivation.

The symptoms are well marked—in both cases the foliage droops from the ends of the branches and the collapse of the plant follows. In *Fusarium* wilt the final collapse may be delayed—the plants may wilt during the day and recover at night—this characteristic accounting for the name " Sleeping disease." The lower leaves turn yellow and in most cases the plant finally collapses.

Bacterial wilt is characterized by the slimy ooze which exudes from the ends of the water-conducting vessels when these are cut across—and in both cases these vessels are discoloured and brown in colour.

These symptoms are due to the invasion of the plant tissues by one or other of the pathogens mentioned. The fungus *Fusarium* may live for long periods on organic matter in the soil—and usually produces large numbers of conidia (spores) on exposed masses of plant material.

Control.—Plants, once infected rarely, if ever, recover and there is no means of treating infected plants. Control measures are therefore directed to prevention of the spread of disease by the following means:—

1. Remove and burn diseased plants and burn all old plants after harvesting is completed.

2. Sterilize seed if possible in a solution of corrosive sublimate (1 in 3,000) for five minutes. Seedlings may be watered occasionally with dilute solutions of Cheshunt compound.
3. Use fresh soil for seed-beds or boxes. Sterilize the soil of seed-beds which should not be near old tomato beds.
4. Do not plant tomatoes repeatedly on the same site but allow at least three years between crops on the same soil.
5. Avoid injury to young plants during transplanting or during staking. In some cases sowing the seed at the stake to avoid transplanting has given useful results.
6. Although truly resistant varieties have yet to be found, certain varieties have shown locally some degree of resistance to fusarial wilt. These are Break O'Day, Marglobe and Denisonia.
7. Select a well-drained sheltered site for tomatoes where the plants will be protected from wind damage.

(To be continued)

A NOTE ON CHARCOAL MAKING.

By

H. W. JACK, M.B.E., D.Sc., B.A.,
Director of Agriculture.

Probably the cheapest method of production of charcoal is the age old method of burning the shell in turf- or mud-sealed heaps 5 to 6 feet high or higher, as used in Malaya. The enclosed heap is fired through a central hole previously filled by a bamboo or other stake 4 to 6 inches in diameter and when the shells are burning thoroughly the supply of air is cut off and carbonisation proceeds automatically without further combustion. By this method good charcoal is produced in about twelve hours after which it is watered and cooled off.

Sometimes covered pits about 6 feet deep are utilised for making the charcoal, a hollow bamboo pipe being placed vertically in the middle of the pile of shell. Paraffin is poured down the pipe and lighted and after the shells are thoroughly alight the pit is covered with damp leaves and earth and then watered. About 1,000lb clean shell (dry) should make about 340lb of charcoal. Leave to cool for three days and if still hot sprinkle with water.

The London specification for charcoal is as follows:—Not more than 10 per cent. moisture, not more than 15 per cent. volatile, uniformly dark, free of fibre, salt and other dirt. It should give a clear ring, if dropped on a concrete floor and the broken edges should show a conchoidal fracture.* Not more than 5 per cent. should pass through ¼-inch mesh and not more than 10 per cent. should remain in a mesh of 1-inch holes.

The manufacture is an art requiring experience and skill and slight misjudgments may easily spoil either by overburning or by undercombustion.

In Malaya the total cost of production used to be £6 per ton, including freight, insurance, loading charges, &c.—it might be a little higher now.

In Fiji, high costs of collecting shell, high interisland transport costs and the need to change the local custom of cutting out copra for one of husking the nuts would tend to render the industry here doubtfully remunerative, except perhaps as an emergency measure, when wages might possibly be temporarily reduced.

* Conchoidal fracture is seen when a piece of flint is broken.—[Editor, Agriculture Journal].

OBSERVATIONS ON CERTAIN WEEDS OF JAVA, MALAYA, MAURITIUS AND MADAGASCAR.

By
H. W. SIMMONDS, O.B.E., F.R.E.S.

THE following notes by H. W. Simmonds, O.B.E., F.R.E.S., on the more important weeds observed in the course of the recent mission to Malaya, Mauritius, Madagascar and Java in connection with rhinoceros beetle control may prove of interest.

Clidemia hirta D. Don.—This melostomaceus plant, formerly so troublesome in Fiji that it was called the " Curse," was met with in several places and, along the eastern coastal area of Madasgascar(1), has reached an intensity equal to that formerly experienced in Fiji. Soil and climatic conditions are similar and the Indian Mynah, *Archidotheres tristis*, is also present to spread it. It first appeared in the neighbourhood of the port of Tamatave and there is no doubt will soon occupy the whole of the wetter coastal area, unless checked by biological methods. There should however be no great difficulty in sending the thrips, *Liothrips urichi*, Karny, from Fiji, via Java, to Tamatave, where it would have the opportubity of doing equally good work. In Java also this plant seems to have spread considerably since the writer's last visit in 1925 and the introduction of *Liothrips* seems worthy of consideration.

In Malaya the writer did not observe the plant in 1925, but now it is common around the Botanical Gardens at Kuala Lumpur and in the jungle on the island of Singapore.

In view of the large area of uncultivated and valuable forest land in this country, the introduction of *Liothrips*, which should be very easy, seems well worth undertaking.

Cordia interrupta D.C.—In cultivated lands in Mauritius this is generally considered their most troublesome weed, springing up quickly on sugar lands as they pass temporarily out of cultivation and forming, with *Lantana camara*, a dense thicket, the eradication of which entails considerable expense before the land can again be placed under cultivation. In Singapore island also, a species of *Cordia*, apparently identical with this, has appeared and, the writer was informed, is spreading with alarming rapidity. The plant is said to be a native of the Central American and West Indian region and its spread is undoubtedly due to bird action. In Mauritius the chief culprit is the Bulbul, *Pycnotus jocosus*, introduced from Madagascar, whilst, to a less extent the Indian Mynah, *Archidotheres tristis*, plays a part.(2)

The plant is of value in that its flowers provide honey for the valuable adult *Scolias*, which have been introduced into Mauritius, but a check on its rapid spread would be of grat value to the Colony. It does seem probable that, in its original home in Central America, there exist agencies inhibiting its increase, the introduction of some of which should give valuable results, both of Mauritius and Malaya.

Ardesia crenata Roxb.—This ornamental red berried shrub, native of south east Asia, has become the most serious weed in forest lands in Mauritius, where it often completely covers the land, even in dense shade and entirely prevents re-generation.

As the plant seems identical with one, frequently seen in gardens in Fiji, it is suggested that it be declared a noxious weed and that steps to taken to eradicate it, before it gains a footing in the forest.

Ligustrum walkeri (Privet).—This shrub, which is very similar to the common privet of Europe, has taken possession of large areas in Mauritius, particularly of forested lands. It does not however seem to tolerate such intense shade as the preceding. The plant is a native of Southern Asia.

Solanum torvum.—In the neighbourhood of Kuala Lumpur the writer saw a number of plants of this pernicious weed, with their flower heads in a very bad state due to the attacks of a Pyralid caterpillar, which proved to be *Psara bipunctatus* F. Despite the presence of several parasites it was undoubtedly seriously reducing the seeding capabilities of many plants, whilst several small ones appeared to have been killed by its attacks.

The writer was informed by Mr. Corbett that, in the Departmental records, this moth was recorded from *Solanum torvusu*, another wild *Solanum* and *S. melangeanum* (Bringal) and *S. verbascifolium* (Bringal). There was no record of it from Tobacco, Potato, Tomato and Capsicum. It had however been recorded from Bermuda, Couch and *Digitaria* grasses. In these last three cases, it seemed probable that a biologically distinct form was involved.

It is not at present recommended that use be made of this larva for the control of *Solanum torvum* in Fiji. The plant is very closely related to several valuable economic species, whilst, as a weed it is, at present, normally found on good land, where hand weeding is not impossible.

Furcreæ gigantea Vent. (Aloe).—This plant is grown commercially in Mauritius, where its fibre is utilised, so that it can hardly be said to be a weed. None the less it is most prolific in its nature and, where the extraction of its fibre is not undertaken, it is a major pest, occupying considerable areas of good quality land. The plant is a native of tropical America.

Acacia eburnea Welld., and *A. farnesiana* Welld.—These two thorn bushes, together with *Eugenia* and Tamarind trees, form an impenetrable jungle in some of the drier portions of Mauritius.

Ravanola Madagascariensis.—This travellers palm, a native of Madagascar, has taken possession of a considerable area in Mauritius, where it is particularly troublesome in water logged land. In its native home in Madagascar it is also somewhat dominant.

Rubus spp. (Brambles).—Two species of brambles were present in Mauritius where one, *Rubus roridus*, forms, in some places, dense thickets. The somewhat tasteless fruit of the other species, of which the writer has not the name, is, to some extent, consumed locally. Incidentally this species might yield some useful hybrids if crossed with raspberry.

Lantana camara L.—This almost universal tropical weed was present in each of the countries visited. In Mauritius it was particularly severe, forming, in company with *Cordia interrupta*, dense thickets along roadsides, railways, and land temporarily out of cultivation. In that country there is a small lepidopterous larva which attacks the foliage and which can be severe, but it seems probable that the introduction of the seed destroying fly, *Agrozyma lantanæ*, and the Tingid, *Teleonemia lantanæ* would prove of considerable value.

Psidium spp. and *Eugenia* spp.—Several introduced Myrtaceæ, including species of the above two genera, have taken possession of much the higher lying lands in Mauritius. Here they form a dense scrubby forest, amongst which a few native plants survive, the whole giving shelter to numbers of introduced pigs, deer, and monkeys.

Stachytarpheta spp. (*Blue rat tail*).—Whilst *Stachytarpheta jamaicensis* is a major weed of poor lands in the Pacific regions and was generally distributed in the countries visited, several other species of the genus were also observed.

None of these have however, so far, assumed the proportions that *jamaicensis* has in Fiji, Samoa and Tonga and, in Mauritius, the plants are sources of honey for certain of the various Scoliidæ which have been introduced into that island of recent years, with the object of reducing the numbers of white grubs attacking sugar cane.

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INDIAN MUSTARD (*Brassica juncea*).

By

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Indian Field Assistant.

MUSTARD is grown on a small scale by farmers for household use in Fiji. Little locally grown mustard seed is sold in the markets, although there is a fair demand. Mustard could be grown all the year round in the Fiji climate.

Seed may be sown in drills or broadcast on a smooth surface of loose friable soil. Germination takes place very quickly, while maturity is reached in about three months. When the pods show signs of ripening the plants are pulled out and dried for two to three days, when they are ready for threshing. Threshing is done by hand, by beating the plants on a platform or lightly beating with a stick, until all seed is threshed out. Care must be taken to prevent, bruising of the seeds. The seed is then winnowed and sundried. Most cultivators grow the crop in garden plots rarely exceeding half a square chain in area and the average yield of dry seed from such a plot is about 30 lb, which is equivalent to 600 lb per acre.

In the Sigatoka river area about 10 per cent. of the cultivators grow mustard seed for their own and their neighbours' use, the local price varying from 6d. to 9d. per lb.

The ground-up seed is used in curries at the rate of half a teaspoonful per meal per family.

The leaves when young are used in the same way as cabbage, and the seeds are much used as a condiment and for flavouring pickles, etc.

REVIEWS.

JEPSON'S BEETLE IN OTHER ISLANDS.

THE following account, translated from a recent French publication*, shows that the Histerid Jepson's beetle (*Plæsius javanus* Er.) sent from Fiji to Tahiti in June, 1937, has been successful in controlling the banana borer in that island in the same latitude as Viti Levu—17° 30'S.

The beetle is tending to increase and a plantation of fei (wild banana) made a marvellous recovery from the moment when the insects were liberated. A young specimen has been found so that the insect is breeding.

It is convenient to summarise here the other localities where this predatorial Javan beetle has been sent from Fiji.:—

February, 1936—Puerto Rico, West Indies.
July, 1937—Jamaica, British West Indies.
December, 1937—Rarotonga, Cook Islands.
February, 1938 and August, 1939—Jamaica.
December, 1938 and June, 1940—Cook Islands.

An interesting sidelight on the ramifications of biological control was provided in a letter to the writer from a resident in Puerto Rico who feared that the liberation of *Plæsius* might be so rapid that the borer (*Cosmopolites*) would be exterminated in ten years. With a resultant increase in the banana crop owing to over-production, there would be a fall in the market price and this fear of overproduction was said to have prevented the buying of banana plantations in this island of 3,500 square miles. —R.J.A.W.L.

* Bulletin de la Chambre d'Agriculture, No. 3, 6th June, 1940, Papeete, Tahiti.

INSECT PESTS OF STORED FOODSTUFFS.

THE last issue of the *Journal* contained a review of two papers dealing with the relation of insects to stored grain. As this subject is likely to be of increasing local importance, further details are given here from a Colonial Office Memorandum on the "Storage of Food Stuffs in the Colonial Empire."

Two essentials for successful storage are: firstly, that the product to be stored is really suitable for storage and secondly, that such conditions can be maintained during the time of storage. Thus, introducing material already infected with insects is almost equivalent to the unsuspecting Trojans bringing in the wooden horse, thereby carrying the enemy into their own beleagured town.

Dealing first with stored grain: it is important to realise that if the moisture content lies between 17 and 20 per cent., it is ideal for attack by weevils which are, however, unable to live in grain containing less than 8 per cent. of moisture. Furthermore, the heating or fermentation which occurs with the higher water content encourages mould (fungi) and bacteria—as is well known to be the case with copra if the moisture is over 6 per cent. For maize, 12½ per cent. of water is the maximum allowed in Kenya and this figure should be aimed at here.

Not only must the moisture content be low, but it must be kept low during storage: this is aided by the container being dry, impervious to ground moisture and moist air.

All stores should be rat proof as a matter of course, and where grain is stored in bags these should not come into direct contact with the floor as circulation of air is checked.

Practically all the common insects pests of grain occur in Fiji: viz. the rice weevil, saw-toothed grain beetle, flour beetle, pea and bean weevils and the fig or cacao moth. Hence if the measures recommended in other tropical Colonies are followed here the pests will be similarly controlled.

The following summary—which is an expansion of that given in our issue for October—of precautions to prevent the spread is important:—

(1) Infested goods should be segregated. Containers, whether sacks or baskets or drums, which have carried infested goods should not be used again until disinfected or sterilized.

(2) Broken goods, screenings and sweepings are especially prone to infestation. They should be isolated and sterilized or burned at the earliest opportunity. On no account should sweepings be returned to the main store.

(3) New season's goods should never be stored with old season's goods unless these older goods are known to be clean.

(4) In inspecting goods for the presence of insects the following places should receive special attention:—

(*a*) between adjacent sacks and baskets;
(*b*) between these and the walls of the store;
(*c*) in the ears and folds at the top of sacks and in the wicker work at the tops and bottoms of baskets;
(*d*) at the highest or the darkest places in bulked goods;
(*e*) on the floor and especially on the walls of stores near infested goods;
(*f*) on the floors of carts, wagons or sledges used in harvesting.

So far as actual control goes, as distinct from the much cheaper prevention, the measures comprise:

(1) fumigation with gas;
(2) sprays;
(3) use of dusts and sticky bands.

(1) Fumigation must always be strong enough to allow for absorption of the gas by the walls of the chamber itself, the bags or boxes around the food-stuff and by the food-stuff itself. Substances rich in fat, such as copra, absorb a much higher percentage of gas then does grain. Besides absorption, allowance must also be made for leakage through cracks and provision made, if necessary, for circulation of the gas by means of punkahs operated from outside. Ventilation of the goods afterwards will get rid of the gas even if hydrogen cyanide is used. Absorption by the walls, floor and ceiling may be ckecked by oil paint or cellulose paint but not with whitewash or distemper. (This should not be confused with the annual whitewashing recommended for stores). Improvised fumigators are:—

(*a*) a water-tight barrel covered with two thicknesses of wrapping paper;
(*b*) a bin with a properly fitting lid sealed with paper and paste;
(*c*) bags of grain, or even loose grain in heaps, covered with a sound tarpaulin properly weighted down all round.

Carbon bisulphide is the most usual fumigator but as it does not kill eggs of insects it normally needs to be repeated. Application is best done by sprinkling from a watering-can one to three gallons of the liquid for every 800 bushels of grain, i.e. 20 tons by weight.

One of the oldest and most efficient gases is hydrogen cyanide but owing to its great toxicity it requires strict supervision. Formerly, the pot method of generating the gas (by means of sulphuric acid on potassium cyanide) was the standard one but recently papier maché discs have supplanted this method. So-called cyanide "units" (a British product) have been found to give satisfaction by the Medical Officer of Health for fumigating ships in Suva harbour.

(2) The next type of control is the spray but as an atomised spray requires an air compressor driven by a petrol engine it is not likely to supplant fumigation. An extract of pyrethrum in white oil or kerosene is best.

(3) The principle of dusts for insect control is that it dries up the body-fluids of the beetles or grubs so that they cannot survive. In British Guiana it was found that adding only one per cent. of precipitated chalk (burnt coral lime might do here) materially reduced weevil damage to rice while similar results were obtained with five per cent. slaked lime in Malaya. Clean dry sand or lime can be added to maize. The use of such dusts with grains is not harmful as rice is normally washed before cooking. This method is said to be "much the most promising" and is strongly recommended for local use, always provided the grain is dry when stored in the first place.

(4) Lastly, we come to sticky bands to prevent access of insects to the grain as is done on fruit trees in many orchards. Their chief merit is that already infested piles of goods can be isolated and then dealt with separately. Care must be taken to see they are renewed if covered with dust which would provide a bridge for insects. The section under review states that bird lime may be procured or made locally so as to avoid buying commercial preparations. It is stated naively that although its manufacture and use may be prohibited, doubtless knowledge of these still persist. —R.J.A.W.L.

KITCHEN WASTE FOR FEEDING FARM STOCK.

If it is assumed that kitchen waste per family per day is in the neighbourhood of 1lb, then the wastage in Suva must be approximately by at least 10 tons per week.

Such waste materials as food scraps, vegetable leaves, potato peelings, bread, bones, banana skins, &c., have a definite food value if converted into feed suitable for pigs and poultry.

Methods of conversion are simple, the main requirement being some convenient form of drier and a grinding machine, so that the waste may be sterilized, dried and ground into a meal, which is a suitable form in which to handle the product.

An analysis of such a meal is given in *Nature* (Volume 146, No. 3689, 1940) by Dr. Bernard Dyer & Partners Ltd., as follows:—

Moisture	7·25 per cent.
Oil or fat	8·00 ,,
Protein (crude albumenoids) ..	20·95 ,,
Digestible carbohydrates	41·17 ,,
Indigestible fibre	7·20 ,,
Mineral matter	15·43 ,,
	100·00 ,,

This analysis indicates that the meal may be regarded as a good concentrated food.

The mineral content is noteworthy because it includes 3·4 per cent. of lime and 1·65 per cent. of phosphoric acid, these being in the satisfactory ratio of 3·4 of calcium to 1 of phosphorus and thus making a mineral supplement unnecessary. Further, the meal would contain about 30 parts of carotene per million—about the same proportion as is found in meadow hay —an important item in the nutrition of stock that does not get a liberal allowance of green food.

Actual farm tests have shown that any mixture containing kitchen waste meal "is eagerly eaten by pigs and poultry and that the response in growth and egg production" is satisfactory. Digestible protein is necessary to repair animal waste, to build up flesh and to perform other vital functions and as it cannot be stored in the system a fresh supply must always be available.

Kitchen waste meal supplies abundant protein, an adequate amount of fat and mineral constituents and thus forms a highly nutritive addition to any general ration. It is estimated that one part of waste meal added to eight parts of any general ration such as maize meal would give a balanced diet for pigs or cattle.

In England waste meal is reported to be worth over £12 per ton to the farmer and to be in heavy demand. Its production in quantity would require the co-operation of housewives in order to assist in the collection of suitable waste to the exclusion of unsuitable materials such as tea leaves, citrus skins, rhubarb leaves, &c.

Should pig production for export develop on a commercial scale locally, an organized effort to collect suitable waste for conversion into a useful feed should be worthy of consideration. —H.W.J.

WASTE PAPER COLLECTION.

It may be mentioned that in Edinburgh (*Nature* Vol. 146, No. 3690, 1940) the revenue from waste-paper alone more than pays the wages of all operatives on refuse collection, sorting and disposal. Waste paper prices are fixed by authority, thus mixed papers are worth 40s. per ton loose, and 80s. per ton if baled, while baled newspapers fetch as much as 127s. 6d. per ton. In the same article it is estimated that one ton of waste-paper can be collected per 1,000 of the population. —H.W.J.

EXTRACTS.

GRAIN DESTRUCTION BY INSECTS.

(From *Nature*, Vol. 146, No. 3694.)

" The field work of the survey* has lasted about a year. Its most important result is the demonstration that infestation occurs throughout all the industries producing, housing, transporting, trading in, manufacturing, or using cereals and cereal products. No single industry therefore, is a in position to accuse another as being the source of the prevailing evil. Compared with the elaborate series of processes used for the cleaning, conditioning and refining of flour, the prevailing methods of storage are almost crude.

" Good ventilation, general cleanliness, segregation of infested consignments and other simple methods of control have yielded results of value. Hygienic measures alone, however, will not provide sufficient control while heavily-infested imported cereals and cereal products are brought into Great Britain.

" The insects infesting grain are not natives of the British Isles: they cannot live and breed in our climate in the open, but only in barns, granaries, warehouses, mills, &c. The links in the chain of distributing infestation begin with the arrival of vessels from overseas and go from them to dock premises, vehicles and containers, and so to mills, merchants, breweries, maltings, farms, &c. The report has done good service in stressing the risks and formulating the problems that have to be met at a time when food conservation is of paramount importance. Also, as a beginning, the recognition of proper cleanliness and the separation of infested from clean grain are steps in the right direction. Since there is a whole chain of circumstances requiring control we have to bear the burden of neglect of applied biology at a time when the nation is facing its greatest crisis."

* " Reports on a Survey of the Infestation of Grain by Insects " (London: H.M. Stationery Office, 1940). 1s. 3d. J. W. Munro.

PRESERVATION OF FISH IN WARM CLIMATES.

(Bulletin of the Imperial Institute, Vol. 37, No. 4, 1939.)

THE principal methods of preserving fish, other than canning, are refrigeration, salting, smoking and drying. The details of the methods used vary in different countries according to local conditions and requirements.

REFRIGERATION.

To produce frozen fish which after several months of storage is equal in flavour and food value to freshly caught fish, it is essential that they should be placed in the freezing room as soon as possible after leaving the water. Bruising or damage hastens their deterioration and they should, therefore, be handled as little as possible. A difficulty in freezing fish in tropical countries is that any very slight increase in temperature causes changes in the flesh which cannot be remedied by freezing. Freezing only keeps the fish in the same condition as that in which it entered the refrigeration chamber and it is therefore essential that it should be in prime condition. Unless fish can be delivered to the chamber within three or four hours after landing they should be kept in ice or under refrigeration in the boats.

Before freezing, all fish should be thoroughly freed from dirt and slime in clean, cold, running water. Either fresh water or sea water may be used, but care should be taken that it is pure. Larger fish are usually "gutted" before being frozen, although practice in this respect depends on the market for which they are intended. Gutting of smaller fish is normally impracticable. Fish containing much oil are apt to deteriorate more quickly than other varieties.

For freezing, the fish are commonly placed in pans which are set on the refrigeration pipes until the fish are frozen. They are removed by pouring a little cold water on the outside of the pan, which causes sufficient melting to allow the frozen fish to be removed from the pan. Where it is desired to freeze each fish separately, they may be placed on trays or shelves over the pipes.

In most modern up-to-date plants the fish are quick-frozen in brine, and this method is stated to give a product superior to that obtained by freezing in air.

After freezing the fish are "glazed." Glazing is designed to encase each fish in a protective coating of thin clear ice which prevents the evaporation of water from the flesh of the fish with consequent shrivelling, helps to prevent the fish turning white, and prevents the entrance of air which tends to make the fish oils deteriorate. Glazing also provides an ice surface on which moulds and fungi cannot grow.

For glazing, the fish are immersed quickly in a trough of clean, fresh water at a temperature just above freezing point, in a room in which the temperature is maintained at 20°F. to 25°F. The water covers the fish with a thin film, which freezes instantly into a thin coating of ice as soon as the fish is withdrawn from the water. The fish are immersed three or four times until the coating of ice is considered sufficient, and every part of the fish is covered.

Another method of glazing is by means of a hose with a special spray nozzle, with which a fine stream of water may be sprayed on the frozen fish.

After glazing the fish are taken to the cold-storage rooms, which are kept at temperatures ranging from −5° to +10°F., and kept until required for market.

SALTING.

Difficulties in salting fish in warm climates are due chiefly to the slow penetration of salt and the rapid decomposition of the fish. In this connection, in experiments carried out in the Fishery Products Laboratory, United States Bureau of Fishery, it was found that calcium and magnesium salts, common impurities found in commercial salt, greatly retard the penetration of the salt into the fish. It was also found that the salt penetrates the fish far more quickly if it is applied as dry salt than if in the form of brine. Of great importance also in the salting of fish in warm climates is the thorough cleaning of the fish before salting, since it was found that while thoroughly cleaned fish could be salted successfully at temperatures of 90°F. to 100°F., fish containing blood, roe and milt spoiled at about 65°F.

Before salt is applied, therefore, the fish should be beheaded, and the entrails, kidney and roe removed, and the fish thoroughly washed, preferably in cold brine about the strength of sea-water, or in fresh water. The fish should be rolled in the salt, which should be as fine-grained as possible, the belly cavities filled, and the fish packed with their backs down, in tubs. A weight should be placed on the fish, sufficient to keep them immersed in the brine formed by the absorption of the water from the fish by the salt, without crushing them. After the fish have become thoroughly saturated with salt, or "struck through," the tubs may be packed full.

Another method of salting which is also used is that of brine salting. In this method the cleaned fish are placed in large vats partially filled with concentrated salt solution. A small amount of salt is put on top of the fish floating in the brine, and the fish are stirred regularly to prevent the brine becoming too dilute at any one point.

The proportion of salt used varies from 10 per cent. to 35 per cent. of the weight of the fish according to the kind of fish, climatic conditions and local customs. The time required for salting depends on the temperature and the size of the fish. Small fish can often be salted in about two days.

For immediately marketing, the fish should be taken from the brine and the brine drained off. More dry salt is then applied, and the fish are packed in containers ready for the market. If the fish are to be held for some time, however, it is necessary to keep them under brine continually to exclude air, which causes the fat in the fish to "rust." For this purpose the barrels should be filled with fish, headed, and nearly filled with brine through the bunghole. In warm climates, however, where possible, salted fish which is not to be consumed for any considerable time should preferably be kept in cold storage.

In connection with the salting of fatty fish, experiments carried out at the United States Bureau of Fisheries Laboratory in 1937 showed that the addition of 30 per cent. of pulverised whole oats, based on the weight of salt used, to the brine in which mackerel were first dipped for salting, considerably reduced rancidity in the fish after storage. As far as the Imperial Institute is aware, however, this process is not being used at present on any commercial scale for the salting of fatty fish.

Another method of preserving fish, which is closely related to salting, is the preservation by means of sodium hypochlorite, which is a powerful perservative and steriliser, and, in acting on organic matter, is converted into sodium chloride. The Madras Fisheries Department have been making preliminary experiments with this method, but it is not used on any commercial scale at present.

SMOKING.

Small fish are usually smoked without evisceration: larger fish are beheaded, eviscerated and often cut into strips or small pieces. In Europe and America fish are generally salted by immersion in brine or by adding dry salt before smoking, the degree of salting depending on the nature of the fish and the type of product desired. In the East, fish are often smoked without any preliminary salting. Before smoking and after immersion in brine fish should be partially dried in the open air.

Smoking is of two kinds, hot-smoking and cold-smoking. In hot-smoking the fish are kept close to the fire and are wholly or partly cooked in the smoking process, which is completed in a few hours. In cold-smoking the fish are hung some distance from the fire and are smoked at a temperature not exceeding 80°F. The time taken for cold-smoking varies, according to the product required, from a few hours to several weeks, as in the case of hard herring.

The woods chiefly used for smoking are hard woods, the most importsnt considerations in choosing the woods being to use one which burns slowly and produces a large amount of smoke. Soft woods which contain resin should not be used, since the resins are liable to give a disagreeable taste to the fish.

The method of building the fire and the erection of the smokehouse depend considerably on the capital available and the quantities of fish to be smoked. For smoking small quantities of fish, a barrel with the lower end of one or two staves removed, is placed on the ground over a small pit, in which the fire is made. The fish for smoking are hung from rods supported at the top of the barrel, and the barrel is then covered with sacking or coarsely woven cloth to keep the smoke in. Fuel may be placed on the fire through the holes made in the barrel by the removal of the staves. In China long narrow furnaces about 3 feet high and 3 feet wide are constructed of stone or concrete, with holes in the top. The smoke from the fire passes through the holes to the fish, which are contained in baskets.

DRYING.

Drying preserves fish by destroying enzymes and removing water which is necessary for bacterial growth. Fish having a fat content of over 0·2 per cent., however, is not suitable for dehydration by ordinary processes since on storage of the fish the oil contained in it becomes rancid.

Methods of drying fish differ according to the locality. The main principles consist, however, of washing and eviscerating the fish and then drying them, usually in the sun, although where suitable plant is available they may be dried in moving air currents or *in vacuo*. The more rapidly the fish are dried the more rapidly they may be re-hydrated when required for use. In some districts the fish are salted or boiled for a short time before being dried. Where unfavourable weather conditions are likely to make drying difficult and prolonged, preliminary salting is probably advisable. For drying, the fish may be hung on poles or placed on mats in the sun.

Although dehydration of fish helps to prevent autolytic* changes and bacterial growth, it does not prevent oxidation of the fat in the fish. Dried fish should, therefore, be stored away from sunlight and warm air. Storage *in vacuo* or in inert gas such as carbon dioxide is preferable, where possible, although where the fish is for fairly immediate consumption such precautions need not be taken.

Dried fish normally weighs only about one-tenth of its weight when fresh, and in this form it can be economically stored and transported.

* Self-produced disintegration.—Editor, *Agricultural Journal.*

PREPARATION OF TOMATO JUICE.

(Bulletin of the Imperial Institute, Vol. XXXVII, No. 4, October–December, 1939.)

TOMATOES to be used for the preparation of juice should possess high colour, rich flavour, high total acidity, be juicy rather than "mealy" in texture, and of the correct degree of maturity. Over-ripeness results in a juice of poor flavour and under-ripeness in one of poor colour as well as poor flavour.

The greatest possible care must be taken in washing, sorting and trimming the fruit. Washing is often done first in a "soaker" washer and then in a rotary washer. The tomatoes are then passed to roller inspection tables where unfit portions of the fruit are removed. The green portions of the fruit are cut away, and some manufactures even remove the core, since it may impart a harsh taste and affect the colour of the final product.

At one time the juice was extracted by passing the raw fruit through a pulper, but it was found that this procedure destroyed practically all the Vitamin C owing to excessive aeration of the juice, and at the same time impaired the flavour of the juice.

To overcome these disadvantages it is now a common practice to heat the fruit in one way or another before expressing the juice and to use special extractors. Some manufacturers pass the tomatoes through a scalder and heat them thoroughly, while others heat the fruit for only a minute or two in live steam, sufficiently to scald the skin and flesh near the surface. In other cases the tomatoes are crushed and heated to boiling point.

Two types of juice extractors are commonly employed in the United States which has the largest production of tomato juice.

One type consists of a tapered screw revolving within a cylinder of perforated metal with holes 20/1000 inches in diameter and 625 holes per square inch. The screw applies a pressure which can be varied to attain the degree of extraction desired. It is usually recommended that not more than 60 per cent. of the fruit be recovered as juice; this yield is attained with light pressure. Heavy pressure gives juice of too thick a consistency and of harsh flavour.

In the other type or extractor known as the "Indiana Juice Machine," there is a hopper in which the tomatoes are cut into small pieces by a cutter which revolves slowly. The cut tomatoes then pass to the screen section of the machine where they come into contact with two roughened rollers. These two rollers revolve in opposite directions, and they crush the fruit and force the juice through the screen.

The juice extractor and other metal equipment should be made of metal that does not affect the flavour or colour of the juice; iron and copper particularly must be avoided. Some forms of stainless steel, monel metal, nickel, aluminium and glass-lined steel are recommended.

Salt is frequently added to the extracted juice, the amount usually being 4 lb to 6 lb per 100 gallons. If added at this stage it should be previously dissolved in a small amount of juice and then stirred in with the bulk of the juice. If added in the dry state there is a tendency for the salt to sink without dissolving. Some producers of tomato juice prefer to add it as small pellets or as a small, measured volume of granular salt to the container during the canning or bottling of the juice.

The juice is finally heated and filled hot into cans or bottles, which are closed and processed at 212°F. Plain cans are generally used although the fresh flavour of the juice is retained to a greater degree in coated cans. In the United States nearly 90 per cent. of the tomato juice manufactured is packed in cans and the remainder in bottles.

The temperature of filling and the time of processing varies with different manufacturers. Some prefer filling at 140° to 150°F., while others consider that 180°F. or over is desirable. The time of the final processing will vary with the initial filling temperature and the size of the can or bottle.

Some manufacturers who aim at a very high quality product interpose a deaeration process between the extraction and the packing of the juice. Various deaerators are in use but the general principle consists in passing the heated juice into a partially exhausted tank, where the air occluded in the juice is removed.

NEW HOST RECORDS OF PESTS.

By

R. J. A. W. LEVER, B.Sc., D.I.C., A.I.C.T.A., F.L.S.

From time to time certain insects well known as pests of particular crops will increase their range and attack other plants. An example is the black-spotted ladybird *Epilachna vigintioctopunctata* F.—locally recorded on leaves of tobacco, brinjal, tomato, Cape gooseberry and vegetable marrow (1) which last year was reported defoliating potato leaves in Tailevu. This year it has injured ground nuts in the same area and potato leaves in Nadroga, skeletonising them and killing the plants. A lead arsenate spray at the rate of three ounces in six gallons of water was recommended, while hand-picking of the younger leaves is said to be economic in Java (2).

The spindle-shaped eggs are laid upright on the surfaces of the leaves and hatch into hairy or spiny larvæ which develop into squat pupæ which hang head downwards on the leaf. The distribution is S.E. Asia, New Guinea, Australia and probably the Solomons.

Another pest which has recently taken to a hitherto unrecorded plant is the corn ear-worm *Heliothis armigera* (Hub.) which was reported from Lautoka damaging pods of dhall (*Cajanus cajan* L.). Tomato and maize are the usual crops attacked in Fiji, cotton not having yet been attacked.

The yaqona or kava plant, *Macropiper methysticum* Forst., is almost free from insect pests, Jepson recording (3) an undescribed root-weevil while a leaf-weevil *Elytrurus smaragdus* Mshll. was recorded by the present writer in 1938. In October, 1940, slight damage was done to the young stems of yaqona and tomato by the Coreid bug of taro, *Brachylybas ventricosus* Le Guill. The root of yaqona is used throughout Fiji and most of Polynesia for preparing an infusion and its low incidence to insect attack is very fortunate for the Fijians.

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RAT CONTROL IN BARBADOS, BRITISH WEST INDIES.

In most copra plantations rats are a source of great loss, Paine having shown (1) that six years ago the damage to nuts (which had set but not matured) was about 30 per cent. on Taveuni. Loss by rats has also been reported recently to growing maize and there is a good deal of damage in most country districts from these rodents. Accordingly the following bait, which has been evolved in Barbados (an island in the same latitude north as Samoa is south and of the same area as Kadavu), may be of interest to local settlers:—

" The procedure of manufacture is as follows:—

1.—Cylinders of three thicknesses of brown wrapping paper are rolled and pasted by hand; women become very expert at this work; one end of the cylinder is closed when made and one end left open. 800 to 1,000 made by one woman per 9-hour day.

2.—These cylinders are dipped in raw linseed oil the day before filling is done and drained.

3.—Thallium sulphate is dissolved in hot water in enamel or wooden buckets and sprayed on to rolled oats in shallow wooden trays, amounts being calculated so that 200 pounds of oats gets one pound of sulphate, well mixed.

4.—Sun-dry the bait and then add coconut oil in proportion—1 pint to 5 pounds of poisoned oats.

5.—We find that around 5 grams of the poisoned bait is an adequate dose per cylinder, which is made approximately 7½ inches in length, and when filled and ends sealed, (open or filling end is folded in and sealed with paraffin wax), the complete bait weighs about 6½ grams.

6.—The filling and sealing of baits is as mechanical and as easily learnt as making the cylinders and hundreds of thousands of the baits are made and distributed annually. The final cost, all inclusive, is around 3 baits for ½d. but a Government subsidy enables the planters to obtain 6 baits for ½d. Baits are laid for the rats as the cane reaping season ends; also around places offering shelter for breeding and water.

7.—The efficiency is high and planters are satisfied with the kill of rats and the reduction in damage to sugar cane.

8.—It need hardly be emphasised that some local alterations and adaptations in this bait may be necessary because of differences in food habits, etc., of rats."

The Entomologist, Barbados—who kindly sent the information—stresses that the amount of the bait varies from 1 lb to 1,000 lb of oats to 1 lb to 100 lb of oats but 200 lb is the favourite figure.

—R.J.A.W.L.

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—R.J.A.W.L

HUMIDITY, RAINFALL AND MEAN TEMPERATURE, SUVA, 1940.

Month.	Maximum humidity.	Rainfall.	Mean temperature.
	Per cent	Inches.	° Fahr.
January	98	5·58	80·5
February	99	4·94	82·6
March	94	17·04	81·1
April	99	14·98	77·2
May	96	5·69	75·6
June..	98	6·06	74·4
July	97	4·62	72·9
August	97	4·78	72·5
September	98	12·25	73·7
October	98	9·98	75·6
November	94	5·10	77·2
December	99	17·04	78·0
Total ..	..	108·06	...

DATA RECORDED BY THE HARBOUR MASTER, SUVA.

In Suva the average rainfall for 55 years is 120·62 inches.

These figures are for the windward or wetter side of Viti Levu; the lee or drier side has an annual rainfall of about 75 inches, practically all in the first four months of the year. —R.J.A.W.L.

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